

CLAIMS

1. An antimicrobial material in an encapsulated form, comprising (i) a core comprising an antimicrobial material and (ii) a shell of encapsulating material, wherein
5 the shell of encapsulating material is impermeable to the antimicrobial material.
2. An antimicrobial material according to claim 1 wherein the antimicrobial material is an antibacterial material.
- 10 3. An antimicrobial material according to claim 1 or 2 wherein the antimicrobial material is a bacteriocin.
4. An antimicrobial material according to claim 1 wherein the antimicrobial material is an antifungal material.
- 15 5. An antimicrobial material according to claim 1 wherein the antimicrobial material is at least natamycin.
6. An antimicrobial material according to claim 3 wherein the bacteriocin is selected
20 from lanthionine containing bacteriocins, *Lactococcus*-derived bacteriocins, *Streptococcus*-derived bacteriocins, *Pediococcus*-derived bacteriocins, *Lactobacillus*-derived bacteriocins, *Carnobacterium*-derived bacteriocins, *Leuconostoc*-derived bacteriocins, *Enterococcus*-derived bacteriocins and mixtures thereof.
- 25 7. An antimicrobial material according to claim 1 wherein the antimicrobial material is at least nisin.
8. An antimicrobial material according to any one of the preceding claims wherein the antimicrobial material is present in an amount to provide a microbicidal or
30 microbiostatic effect.
9. An antimicrobial material according to claim 8 wherein the microbicidal or microbiostatic effect is a bactericidal or bacteriostatic effect.
- 35 10. An antimicrobial material according to claim 9 wherein the bactericidal or

bacteriostatic effect is in respect of Gram-positive bacteria.

11. An antimicrobial material according to claim 9 wherein the bactericidal or bacteriostatic effect is in respect of an organism selected from species of *Bacillus*,
5 species of *Clostridium*, *Listeria monocytogenes*, lactic acid bacteria, *Leuconostoc*,
Carnobacterium, *Enterococcus*; *Brochothrix thermosphacta* and *Lactobacillus* species.

12. An antimicrobial material according to claim 9 wherein the bactericidal or bacteriostatic effect is in respect of *Listeria monocytogenes*.

10

13. An antimicrobial material according to any one of the preceding claims wherein the shell is selected to provide sustained release of the antimicrobial material from the encapsulated antimicrobial material.

15 14. An antimicrobial material according to any one of the preceding claims wherein the shell is selected to prevent, reduce or inhibit degeneration or inactivation of the antimicrobial material.

15 15. An antimicrobial material according to any one of the preceding claims wherein the shell is selected to release the antimicrobial material from the encapsulated antimicrobial material under predetermined conditions.

25 16. An antimicrobial material according to any one of the preceding claims wherein the shell is selected to release the antimicrobial material from the encapsulated antimicrobial material on contact with a foodstuff.

17. An antimicrobial material according to claim 16 wherein the foodstuff is a marinade.

30 18. An antimicrobial material according to any one of the preceding claims wherein the shell of the encapsulated antimicrobial material is capable of withstanding injection.

35 19. An antimicrobial material according to any one of the preceding claims wherein the shell of the encapsulated antimicrobial material is capable of withstanding a pressure of greater than 1.5 bar.

20. An antimicrobial material according to any one of the preceding claims wherein the encapsulated antimicrobial material is a particulate form.
- 5 21. An antimicrobial material according to any one of the preceding claims wherein the encapsulated antimicrobial material has an average particle size of less than 150µm.
22. An antimicrobial material according to any one of the preceding claims wherein the shell is selected to provide sustained release of the antimicrobial material from the
10 encapsulated antimicrobial material.
23. An antimicrobial material according to any one of the preceding claims wherein the shell is selected to prevent, reduce or inhibit degeneration or inactivation of the antimicrobial material.
- 15 24. An antimicrobial material according to claim 18 wherein degeneration is by one or more factors selected from heat degradation, pH induced degradation, protease degradation and glutathione adduct formation.
- 20 25. An antimicrobial material according to any one of the preceding claims wherein the shell is or comprises a material selected from fats, emulsifiers, waxes (animal, vegetable, mineral or synthetic), liposome-forming lipids, hydrocolloids, natural or synthetic polymers and mixtures thereof.
- 25 26. An antimicrobial material according to claim 25 wherein the lipid is a glycerophospholipid or and sterol.
27. An antimicrobial material according to claim 25 or 26 wherein the fat is a triglyceride.
- 30 28. An antimicrobial material according to claim 275 wherein the triglyceride is a vegetable triglyceride.
29. An antimicrobial material according to any one of claims 25 to 28 wherein the
35 emulsifier is selected from polysorbates, monoglycerides, diglycerides, acetic acid esters

of mono-diglycerides, tartaric acid esters of mono-diglycerides and citric acid esters of mono-diglycerides.

30. An antimicrobial material according to any one of claims 25 to 29 wherein the
5 hydrocolloid is cross linked.

31. An antimicrobial material according to claim 30 wherein the hydrocolloid is carrageenan.

10 32. An antimicrobial material according to any one of the preceding claims wherein the encapsulated antimicrobial material is prepared by or is obtainable by a process selected from spray cooling, and fluidised bed coating.

15 33. An antimicrobial material according to any one of the preceding claims wherein the encapsulated antimicrobial material further comprises a chelator.

20 34. An antimicrobial material according to claim 33 wherein the chelator is selected from EDTA, citric acid, monophosphates, diphosphates, triphosphates and polyphosphates.

35. An antimicrobial material according to claim 33 or 34 wherein the chelator enhances the antimicrobial activity and/or antimicrobial spectrum of the antimicrobial material.

25 36. An antimicrobial material according to claim 33, 34 or 35 wherein the chelator enhances the antimicrobial activity and/or antimicrobial spectrum of the antimicrobial material in respect of Gram-negative bacteria.

30 37. A composition comprising
(i) an antimicrobial material according to any one of the preceding claims
(ii) a carrier.

38. A composition according to claim 37 wherein the carrier is or comprises brine.

35 39. A composition according to claim 37 or 38 wherein the carrier and the

encapsulated antimicrobial material have substantially the same density.

40. A composition according to claim 37 wherein the encapsulated antimicrobial material is modified to have substantially the same density as the carrier.

5

41. A composition according to claim 40 wherein the encapsulated antimicrobial material is modified by contacting the encapsulated antimicrobial material with oil.

42. A composition according to claim 41 wherein the oil is brominated oil.

10

43. A composition according to claim 41 or 42 wherein the carrier is modified to have substantially the same density as the encapsulated antimicrobial material.

44. A composition according to claim 43 wherein the carrier comprises xanthum gum.

15

45. A composition according to any one of claims 37 to 43 wherein the carrier comprises an emulsifier.

46. A protected foodstuff comprising

20

(i) a foodstuff, and

(ii) an antimicrobial material according to any one of claims 1 to 36 or a composition according to any one of claims 37 to 45

47. A protected foodstuff according to claim 46 wherein the foodstuff is selected from raw meat, cooked meat, raw poultry products, cooked poultry products, raw seafood products, and cooked seafood products.

25

48. A protected foodstuff according to claim 47 wherein the foodstuff is raw meat.

49. A protected foodstuff according to claim 47 wherein the foodstuff is a raw or cooked poultry product.

30

50. A protected foodstuff according to claim 46 or 47 wherein the foodstuff comprises whole meat muscle.

35

51. A process for introducing an antimicrobial material into a foodstuff comprising
(i) providing the antimicrobial material in an encapsulated form comprising a core of antimicrobial material and shell of encapsulating material
(ii) introducing encapsulated antimicrobial material into or onto the foodstuff.

5

52. A process according to claim 51 wherein the encapsulated antimicrobial material is introduced into or onto the foodstuff by (a) injecting the encapsulated antimicrobial material into the foodstuff or (b) tumbling the encapsulated antimicrobial material with the foodstuff.

10

53. A process according to claim 51 or 52 wherein the encapsulated antimicrobial material is introduced into the foodstuff by injecting the encapsulated antimicrobial material into the foodstuff.

15 54. A process according to claim 51 or 52 wherein the encapsulated antimicrobial material is introduced into or onto the foodstuff by tumbling the encapsulated antimicrobial material with the foodstuff.

55. A process according to claim 46 wherein

- 20 (i) the antimicrobial material is at least nisin,
(ii) the antimicrobial material is present in an amount to provide a microbicidal or microbiostatic effect in respect of *Listeria monocytogenes*,
(iii) the shell is selected to prevent, reduce or inhibit degeneration or inactivation of the antimicrobial material by one or more factors selected from heat degradation, pH induced
25 degradation, protease degradation and glutathione adduct formation; and
(iv) the foodstuff is selected from raw meat products, cooked meat products, raw seafood products, cooked seafood products, raw poultry products and cooked poultry products.

56. A foodstuff prepared by a process as defined in any one of claims 46 to 55.

30

57. A foodstuff obtainable by a process as defined in any one of claims 46 to 55.

58. An antimicrobial material as substantially hereinbefore described with reference to any one of the Examples.

35

59. A composition as substantially hereinbefore described with reference to any one of the Examples.

60. A process as substantially hereinbefore described with reference to any one of
5 the Examples.

61. A foodstuff as substantially hereinbefore described with reference to any one of the Examples.